Solar Storms, Why We Care,
a conversation with astronomer Sten Odenwald

Our Sun traces a dependable path across our skies every day, yet only very recently have we discovered that it has its share of stormy days.

For the last three centuries, solar activity levels have come and gone in a roughly 11-year cycle that we have actually grown to expect.

Even our biosphere shows the unmistakable traces of these cycles resonating in everything from the carbon-14 abundances in tree rings…

…to global precipitation patterns and coral layering.
Our eyes never see the Sun brighten or dim, nor are we even remotely aware that the Sun cycles back and forth from stormy to quiescent. But the Sun has a big effect on the hidden aspects of our environment..

Somewhere in the dark space between the solar photosphere and our Earth lies the secret of our Sun-Earth connection.

The Sun is the source of most of the energy on Earth--the power source for plants; the weather we experience each day; the source of warmth that makes life possible. None would exist without it.
Hello, I'm Sten Odenwald an astronomer at Catholic University whose research in space weather science has led me to NASA's Goddard Spaceflight Center.

(Over the next 30 minutes) (During this series of Vodcasts) I will be your guide to understanding the forces at work within our Sun; how those forces affect life on Earth; and the research being conducted to understanding the Sun-Earth Connection.
The study of the Sun is one of the most fascinating and practical fields of study in astronomy.

Even though the Sun is 93 million miles away from Earth, the power of the Sun influences our lives much more than just the warmth you feel on your face.

Just ask the sailors who were on a ship like this, back in the 1800's…

September 2, 1859 was a day of hell for the clipper ship Southern Cross.
The seas were rough that day off the coast of Chile.
Hailstorms and high waves mercilessly fought the crew on as they tried to save their ship.
Many of these sailors had been through storms like this before but at 1:30am the crew saw a sight the likes of which struck terror in their souls.

It was as if the sea and sky became an ocean boiling in blood.

The clouds glowed red which the rough seas reflected. Meanwhile, the aurora australis was alive with unusual activity. It's light was so strong that it pierced the storm clouds.

Then there was another spectacular sight.

As the storm waned, the crew saw
crimson lights on the horizon as if a
powerful armada was in battle.
Ghostly curtains of light snaked across the sky like some alien searchlight from deep space.

The ship's compass refused to point in any direction.

Many of the sailors thought that gthe end of the world had come.

When the ship finally berthed in San Francisco, the crew discovered the drama had not been confined to Chile.
Two thirds of the Earth's skies were also covered by the same event.
Telegraph systems worldwide went haywire.
Spark discharges shocked telegraph operators and set the telegraph paper on fire. Even when telegraphers disconnected the batteries powering the lines, aurora-induced electric currents in the ground still allowed messages to be transmitted.

It was as if today's internet had been wiped out.
WHAT happened?
On the day before this event, astronomers Richard Carrington and Roger Hodgson both witnessed an unusual solar flare on the surface of the Sun.
Carrington was studying sunspots. The one he witnessed that day was huge, almost ten times the diameter of Earth. Suddenly, two beads of searing white light erupted over the sunspots during a five minute period.
No one had ever seen the Sun behave this way before.

What Carrington saw was a solar flare, a magnetic explosion on the Sun.

Solar flares happen most frequently around the time of sunspot maximum.
A single large flare can provide the energy needs for the entire world for over 10,000 years!
Solar flare explosions usually eject huge clouds of electrically-charged particles into space called Coronal Mass Ejections. When the CMEs strike the Earth's magnetic fields, they set in motion a series of dominoe falls that quickly produce the aurora in the atmosphere.
They also cause technology to malfunction. We astronomers call the Sun's stormy condition, "Space weather." The historical record of these storms tell us a dramatic story.
In 1921, a fire burned down the Central new England Railway Station in Brewster, New York.
In 1946, a passenger airplane crashed in Gander, Newfoundland killing 18 people on board.

Solar interference in 1956 caused a major surge for the Akron submarine whose signal suddenly stopped.
And in 1972, a huge solar flare knocked out long-distance telephone communication all across Illinois.
A massive CME on March 13, 1989, provoked geomagnetic storms that disrupted electric power transmission from the Hydro Québec generating station in Canada, blacking out most of the province and plunging 6 million people into darkness for 9 hours; aurora-induced power surges even affected power transformers in New Jersey.
In December 2005, X-rays from another solar storm disrupted satellite-to-ground communications and Global Positioning System (GPS) navigation signals for about 10 minutes. It may not sound like much, but as Bell scientist Louis Lanzerotti noted, "I would not want to be on a commercial airplane being guided in for a landing by GPS."
Throughout the last 500 years, the scale of the solar storm of 1859 has never been equaled. Even the most spectacular recent storms are less than half intense.
With our current reliance on computer technology, another "Carrington-event" could cost us billions of dollars
Cell phone communications and GPS receivers could be disrupted by solar radio noise.
A recent paper estimates potential damage to the 900-plus satellites currently in orbit around the Earth and could cost between $30 billion and $70 billion.

Humans in space would also be in harm's way. Spacewalking astronauts might have only minutes after the first flash of light to find shelter from energetic solar particles following close on the heels of those initial photons.
Hours later, high energy protons

During a super storm –and behind only a few centimeters of aluminum, the shielding found in the average spacecraft – astronauts could still suffer a dose that could cause radiation sickness. If outside in a spacesuit during a spacewalk, the radiation might even be life threatening.

It is no wonder NASA and other institutions around the world have made the study and prediction of solar flares an urgent priority.
Right now a fleet of spacecraft is monitoring the sun, gathering data on flares big and small that may eventually reveal what triggers the explosions.
Hinode, STEREO, SOHO, ACE and others are already in orbit while new spacecraft such as the Solar Dynamics Observatory are being readied for launch.

Research won't prevent another Carrington flare, but it may make the "flurry of surprise" a thing of the past and give us time to prepare against the effects of solar flares.
I'm Sten Odenwald.